Clean Version of Amended Specification

Page 2, paragraph 1 and 2

BACKGROUND OF THE INVENTION

The invention relates to a method for the contactless measurement of the thickness of transparent materials and a device for performing the method. The method is particularly suitable for the wall thickness measurement of container glass.

a1 BRIEF DESCRIPTION OF THE BACKGROUND OF THE INVENTION INCLUDING PRIOR ART

a.2 Devices are already known for the automatic contactless or thickness measurement. (DD 261 832, EP 584673, US 4,902,903, US 3,807,870). These devices employ a laser beam, which is directed onto the object to be measured under a certain angle of incidence.

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It is furthermore disadvantageous in connection with these known devices that the wall thickness measurement value is heavily influenced by the non-parallelity of the wall of the measurement object. The two reflected laser beams are propagated in parallel only, in case when the reflecting surfaces of the object to be measured are disposed in parallel. In the reflected surfaces of the object to be measured enclose that wedge angle, then the two reflected beams diverge or converge, whereby the measured value can be falsified to such an extent that it becomes useless.

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A further erroneous influence and result is associated with the tipping between the measurement device and the measured object. It is not always assured in particular with measurements in connection with running production that the object to be measured is exactly positioned. The vertical to the surface at the measurement location can therefore deviate in practical situations by a tipping angle relative to the measurement direction of the measurement device.

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SUMMARY OF THE INVENTION

1. Purposes of the Invention

It is an object of the present invention to furnish a method and a device for performing the method, which allow to obtain reliably reflexes even at non-ideally smooth surfaces of the measurement object and thereby measurement values, wherein the measurement values are not simultaneously falsified by wedge walls and tippings of the measurement object and which method and device delivers evaluable reflexes on the sensors even in case of heavily curved, wedged walls despite a limited aperture of the receiving optics.

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2. Brief Description of the Invention

The object is accomplished according to the present invention in that the light is initially collimated and then focused onto the surface of the object to be measured under an angle of incidence relative to the vertical or normal relative to the surface. The two reflexes of the light, that occur at the front side and at the backside are imaged onto an opto-electronic image resolving sensor. At the same time the light from a second illuminating surface is also initially collimated and in the following focused onto the surface of the object to be measured under an angle of incidence, wherein the angle of incidence corresponds angle of reflection of the reflected beam from the first illuminating surface. The reflexes of the second light beam are imaged onto a second opto-electronic image resolving sensor. The average value of the distances of the respective two reflexes on the opto-electronic image resolving sensors are determined as a measure of the wall thickness in a following controller.

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The essence of the invention comprises image illuminating surfaces onto the surface of the object to be measured. The impingement of the surface of the object to be measured occurs from the most different directions of incidence by employing a diffusely illuminating surface instead of a sharply bundled laser beam. The course of beams out of an illuminating surface, wherein the course of beams is focused on the surface of the container, contains a large bandwidth of light bundles, which impinge onto the container surface from different angles of incidence. This assures that parts of the course of the beams are always reflected back into the receiving optics despite the grained, uneven surface of the object to be measured, even though other bundles out of the beam course are not available based on these surface defects. Thus always two reflexes are generated on the opto-electronic image resolving sensor.

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BRIEF DESCRIPTION OF THE DRAWING

In the accompanying drawing, in which is shown an embodiment example of the invention:

Fig. 1 is a view of a schematic diagram showing a method and device for measurement of wall thickness of container glass.

DETAILED DESCRIPTION OF THE INVENTION

The illuminating surface 11, which for example is realized by a line shaped light exit opening of a light guide, is followed by lens 12. This lens generates a parallel beam from the diverging beam exiting from the illuminating surface 11, wherein he parallel beam is directed into the objective 14 through the semi permeable mirror 13. The objective 14 focuses the beam onto the surface of the container 1 under an angle of incidence. Two reflexes are reflected back from the surface of the container 1 from the front side and from the inner side of the container. These two reflexes are imaged through the objective 24 and through the semi permeable mirror 23 and further through the lens 25 onto the line sensors 26. The controller 3 is disposed following to the line sensor 26, wherein the controller 3 determines the distance of the reflexes and uses the distance between the reflexes as a base for the further calculation of the wall thickness.

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At the same time the lens 22 is disposed following to the illuminating surface 21, wherein the illuminating surface 21 is again realized by a line shaped light exit opening of a light guide. Again this lens generates a parallel beam from the diverging beam which exits from the light guide 21, wherein the parallel beam is directed to the semi permeable mirror 23 into the objective 24, wherein the objective 24 also focuses the beams under an angle of incidence onto the surface of the container 1. This angle incidence corresponds to the exit angle of the reflexes from the first illuminating surface 11. Similarly two reflexes derived from the front side 1.1 and from the inner side 1.2 of the container are reflected back from the surface of the container 1. These two reflexes are imaged through the objective 14, through the semi permeable mirror 13 and further through the lens 15 onto the line sensor 16. The line sensor 16 is again connected to the controller 3, wherein the controller 3 also determines the distance between these two reflexes and uses the distance between these two reflexes as a base for the further calculation of the wall thickness. The wall thickness is finally determined by an averaging of the distances determined with the two sensors 16 and 26.